INFORMATION ON DOCTORAL THESIS

1. Full name: Nguyen Thi Thuy Anh   2. Sex: Male

3. Date of birth: 12/02/1984

4. Place of birth: Truong Vinh Ward, Nghe An Province

5. Admission decision number: 1200QĐ - CTSV   Dated: 29/12/2020

6. Changes in academic process: ....

(List the forms of change and corresponding times)

7. Official thesis title: Research on the development of machine learning techniques for knowledge graph completion.

8. Major: Information Systems   9. Code: 9480104

10. Supervisors:

   1. Associate Professor Dr. Ha Quang Thuy

   2. Associate Professor Dr. Phan Xuan Hieu

11. Summary of the **new findings** of the thesis:

The subject of this dissertation is knowledge graph completion models and the techniques applied within those models.

The scope of this dissertation focuses on techniques and improvement strategies applied to knowledge graph completion (KGC) models. Specifically, it investigates transfer learning techniques on open-domain KGC datasets such as OlpBench, ReVerb45K, ReVerb20K, FB15K237, and WN18RR; adversarial training techniques on multi-modal datasets including DB15K, MKG-W, and MKG-Y; and diachronic embedding techniques on temporal datasets such as ICEWS14, ICEWS05-15, and GDELT.

The dissertation employs a mixed research methodology, including:

- **Qualitative research method**: The dissertation conducts qualitative analysis (following a read – reflect - interpret approach) of concepts and models drawn from relevant literature. It focuses on both overview studies and in-depth research materials aligned with the dissertation's objectives, through which new techniques and models for knowledge graph completion are proposed.

- **Quantitative research method**: The dissertation conducts quantitative research by implementing corresponding experimental systems and executing experimental scenarios to evaluate the performance of the proposed techniques and models. These evaluations serve to verify and assess the effectiveness of the dissertation's contributions.

The dissertation makes the following three main contributions:

- A knowledge graph completion model based on transfer learning, named BERT/FastText-GRU-KGC, is proposed and improved from the original GloVe-GRU-KGC model introduced by V. Kocijan and T. Lukasiewicz in 2021. The proposed model leverages source resources from BERT and FastText language models instead of GloVe and enhances the encoder component of the original architecture. Experimental evaluations demonstrate that the improvements are effective when compared to the original GloVe-GRU-KGC model. This research contribution has been published in [AnhNTT1].

- Two multimodal knowledge graph completion models, ViT-AdaMF-MAT and T5-ViT-AdaMF-MAT, are proposed and improved from the original AdaMF-MAT model introduced by Y. Zhang et al. in 2024. These models incorporate Vision Transformer (ViT) for image embedding and T5 for text embedding. Experimental evaluations demonstrate that the proposed enhancements are effective when compared to the original AdaMF-MAT model. This research contribution has been published in [AnhNTT4].

- Two temporal knowledge graph completion models, DE-RotatE and DE-RotatE-sinc, are proposed and improved from the original DE-SimplE model introduced by R. Goel et al. in 2020. These models adopt rotational projection instead of translational projection used in DE-SimplE. Experimental evaluations demonstrate that the proposed improvements are effective when compared to the original DE-SimplE model. This research contribution has been published in [AnhNTT2, AnhNTT3].

12. Practical applicability, if any: ....

13. Further research directions, if any:

- Investigate the impact of transfer learning methods in knowledge graph completion to gain deeper insights into what the models learn, rather than merely measuring overall performance.

- Analyze the CMR (Contrastive Learning, Memorization, and Retrieval) framework for multimodal knowledge graph completion to propose improvements and develop a new multimodal completion model.

- Connect the dissertation's findings on temporal knowledge graph completion models as DE-RotatE and DE-RotatE-sinc with the use of 2D/3D convolutional operations in diachronic embeddings, in order to upgrade and enhance these models.

- Conduct error analysis to provide a foundation for future research directions.

14. Thesis-related publications:

[AnhNTT1] Thuy-Anh Nguyen Thi, Thi-Hong Vuong, Thi-Hanh Le, Xuan-Hieu Phan, Thi-Thao Le, Quang-Thuy Ha. *Knowledge Base Completion with transfer learning using BERT and fastText*. KSE 2022: 1-6. **Scopus, DBLP[3]**. This study has been cited by other researchers in **Scopus-indexed** publications.

[AnhNTT2] Thuy-Anh Nguyen Thi, Viet-Phuong Ta, Xuan Hieu Phan, Quang-Thuy Ha. *An Improvement of Diachronic Embedding for Temporal Knowledge Graph Completion*. ACIIDS (2) 2023[4]: 111-120. **Scopus**, **DBLP**. This study has been cited by foreign researchers in **Scopus-indexed** publications.

[AnhNTT3] Thuy-Anh Nguyen Thi, Hieu Cong Nguyen, Xuan-Hieu Phan, Quang-Thuy Ha. *Time Factor in Diachronic Embedding for Temporal Knowledge Graph Completion*. Book of Abstracts, International Joint Conference on Rough Sets (IJCRS 2023), pp. 26-28.

[AnhNTT4] Thuy-Anh Nguyen Thi, Cong-Hoang Le, Viet-Phuong Ta, Xuan-Hieu Phan, Quang-Thuy Ha. *The Impact of Embeddings on the Performance of Multi-modal Knowledge Graph Completion*. KSE 2024. **Scopus, DBLP**.

Date: ……………………..   Date: ……………………..

Signature: …………………   Signature: …………………

Full name: ………………   Full name: ………………

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[3] https://dblp.org/pid/334/3367.html

[4] International CORE Conference Rankings (ICORE): Rank B. http://portal.core.edu.au/conf-ranks/2188/